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ON THE FISHERY AND POPULATION DYNAMICS OF SEER FISH *SCOMBEROMORUS COMMERSON* (LACEPEDE) OFF TUTICORIN (GULF OF MANNAR)

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ABSTRACT

On an average 34,476 t of seer fish were landed in India during 1982-1985. *Scomberomorus guttatus* constituted 50% of the total catch, *S. commerson* 49.1%, *S. lineolatus* 0.6% and *Acanthocybium solandri* 0.3%. In Gulf of Mannar, seer fish are exploited by drift gill nets of different mesh sizes, hooks and lines, trawl nets and to a limited extent by shore-seines. On an average 421.4 t of seer fish are being landed annually by all these gears along Tuticorin coast. The drift gill net, *paruvalai* landed on an average 156.7 t at the catch rate of 46.5 kg per unit. Hooks and lines landed annually 141.2 t at the catch rate of 14.6 kg per unit and trawl nets 113.4 t at the catch rate of 3.04 kg per unit. The smaller mesh sized drift gill net, *podivalai* landed on an average 10 t annually at the catch rate of 8.65 kg per unit.

The fishery of seer fish in Tuticorin is supported by *Scomberomorus commerson* (91%), *S. lineolatus* 6.9%) and *S. guttatus* (2.1%). The growth in length of *S. commerson*, estimated from length frequency studies, can be expressed by the von Bertalanffy growth formula (VBGF), $Lt = 1938\ (1 - e^{-0.2006\ (t + 0.0835)})$. The growth in weight may be expressed as $Wt = 32002\ (1 - e^{-0.2214\ (t + 0.1297)})^3$. The natural, total and fishing mortality rates have been estimated with respect to different gears. The yield per recruitment for different combinations of age at first capture and fishing mortality rates for the prevailing M K ratio is estimated and given in the form of yield isopleth. The estimated optimum age of exploitation is 3.88 years and the potential yield per recruit is 1749 g.

The highly selective gears like the drift gill net, *paruvalai* and hooks and lines have been observed to exploit seer fish resource very effectively and more number of larger individuals have been caught. Therefore, exploitation by *paruvalai* with still larger mesh size and hooks and lines may be encouraged for enchancing the production of this resource.

INTRODUCTION

Seer fishes are commercially important scombroids caught all along the coastal waters of India. Though this resource forms a good fishery all along the Indian coast, the information available on the fishery and biology of the component species are limited. Hornell (1917) dealt the seer fish fishery of Tuticorin coast along with other important fishes. Subsequently Chacko *et. al.* (1962) have studied the scombroid fishery of Madras State. Silas (1962) has given an account on the fishery of seer fish while dealing in detail the fishery of tuna, sailfish and marlins along the Tinneveli coast. Biological aspects like food and feeding, growth and spawning of different species of seer fish have been studied by several workers (Vijayaraghavan, 1955; Krishnamoorthi, 1957; Nayar, 1958; Kaikini, 1960; Rao, K. Srinivasa, 1962; Kumaran, 1962). Devaraj (1977, 1982) has worked in detail the growth and biology of seer fishes in Palk Bay. A detailed account is given on the fishery, extent of exploitation and population dynamics of the dominant species *Scomberomorus commerson* in this paper.

FISHERY

Fishing ground, season, craft and gear

This resource is being exploited all along the Indian coast by both mechanised and non-mechanised fishing units althrough the year by employing different types of gears like drift gill net, hooks and line, trawl net, shore-seine etc. Present exploitation is limited to the nearshore waters upto the depth of 50 m by trawlers and beyond 50 m by drift gill net and hooks and line units. Drift gill nets are of different types varying in mesh size from 25 mm to 205 mm with different vernacular names from region to

region. Smaller mesh sized gill nets are employed for exploiting smaller clupeids like sardines and anchovies and the bigger one for sharks and rays. Gill nets with larger mesh size from 120-170 mm have been observed very efficient in catching seer fish. Hooks of different sizes are used in hand line, long line and trolling. The gill nets and hooks and lines have been found to be highly selective and exploit this resource effectively whereas the trawl net and shore-seine are less selective and only smaller individuals of seer fish are caught more in these gears. Though this resource is exploited althrough the year, the peak period of fishing is during July to September off Tuticorin as in the west coast and November to January along the east cost.

Rate of exploitation

On an average 34,476 t of seer fish were landed in India in a year during 1982-83 to 1934-85 period (Table 1). The catch was constituted by the king seer, *Scomberomorus commerson* (49.1%), spotted seer, *S guttatus* (50%), streaked seer, *S. lineolatus* (0.6%) and *Acanthocybium solandri* (0.3%). *S commerson* constituted the major portion of the catch during 1982-83 and 1984-85. This species occurs predominantly along the southern coasts of India and *S. guttatus* occurs in good abundance on the northern coasts of India. *S. lineolatus* and *A. solandri* do not form a fishery anywhere and the occurrence of the latter is very sparce. This resource is exploited mostly

TABLE 1

*Specieswise all India seer fish landing in tonnes from 1982-83 to 1984-85.**

Species	Year			Average	%
	1982 - 83	1983 - 84	1984 - 85		
S. commerson	19,799	13,433	17,548	16,926.7	49.1
S. lineolatus	176	286	186	216 0	0.6
S. guttatus	13,627	21,900	16,218	17,248.3	50.0
A. solandri	9	201	44	84.7	0.3
Total	33,611	35,820	33,996	34,475.7	

*Anon 1986

by drift gill nets and trawl nets along the northern coasts of India (Sudhakara Rao and Kasim, 1985; Kasim and Mohamad Zafar Khan, 1986). In southern coasts hooks and lines are also employed in addition to drift gill nets, trawl nets and shore-seines.

The fishery of seer fish in Gulf of Mannar is commercially very important as the fishermen migrate from northern coast of Tamil Nadu for exploiting this resource along with tuna during the peak fishing season from July to September every year. Among the different gears operated off Tuticorin, *Chalavalai* a type of drift gill net with mesh size 25-35 mm always landed only a very small size groups of seer fish during April-June and sometimes during September-November, whereas the *podivalai* another type of gill net with mesh size 70-100 mm and trawl net land little bigger size groups. *Paruvalai*, a drift gill net with mesh size 120-170 mm and hooks and line always land bigger size groups and the larger individuals are dominant in the catches of these gears.

The observation on this fishery during 1980-85 along Tuticorin coast in Gulf of Mannar reveals that annually 421.4 t of seer fish were landed by *paruvalai, podivalai,* hooks and line and trawl net. Among the three species *S. commerson* constituted the major portion of the catch (91%) followed by *S. lineolatus* (6 9%) and *S. guttatus* (2.1%). The occurrence of *A. solandri* was very rare. *Paruvalai* landed on an average 156.7 t at the catch rate of 46.5kg per unit. There has been a decline in the catch

TABLE 2

Species composition, total catch, effort and catch per unit effort of seer fish landed by different gears operated off Tuticorin.

Gear	Year	*S. commerson* (kg)	*S. lineolatus* (kg)	*S. guttatus* (kg)	Total (kg)	Effort (units)	CPUE (kg)
Drift Gill net	1980	197101	32194	2316	231611	3874	59.8
	1981	136508	35837	779	173124	3964	43.7
Paruvalai	1982	144175	12688	757	157620	4049	38,9
	1983	54810	8337	1335	64482	1584	40.7
Average		133148 5	22264	1296.8	156709.3	3367.8	46.5
	1980	19159	2783	1094	23036	1791	12.9
	1981	3221	259	159	3639	531	6.9
Podivalai	1982	3779	1065	420	5264	1119	4.7
	1983	7348	731	157	8236	1206	6.8
Average		8376.8	1209.5	457.5	10043.8	1161.8	8.7
Hooks & lines	1980	185770	5995	365	192130	11723	16.4
	1981	96797	1166	—	97973	7462	13.1
	1982	152078	4756	645	157479	8979	17.5
	1983	111004	6037	188	117229	10476	11.2
Average		136412.3	4488.5	299.5	141202.8	9660	14.6
	1984	62886	2066	3471	68423	29603	2.3
Trawl net	1985	129276	1091	6845	137212	38177	3.9
	1986	124943	465	9290	134698	44228	3.04
Average		105701.7	1207.3	6535.	113444.3	37336	3.04

rate from 1930 with marginal increase in 1983. *Podivalai* landed only 10 t in a year at the catch rate of 8.65 kg per unit. The trend in the catch rate was as observed in *paruvalai.* Hooks and line units have landed 141.2 t annually at the catch rate of 14.6 kg per unit and the catch rate was fluctuating. Trawlers landed on an average 113.4 t in a year during 1984-86 at the catch rate of 3.04 kg per unit (Table 2).

POPULATION DYNAMICS

The catch statistics of different gears reveal that the seer fish catch is constituted mostly by the king seer, *S. commerson*. It was felt essential that various population parameters such as the growth, mortality rates and yield per recruitment of this species have to be studied for providing required information for better management of the fishery of this species. Forkal length in mm and wet weight in g of this species were collected at random from catches of different gears for length frequency and length-weight relationship of *S. commerson* can be expressed as Log W = - 1.9599 + 2.8479 Log L.

Growth

The gearwise primary data on the observed length frequency were initially raised to the day's catch and then to the month's catch to obtain the weighted length frequency at an interval of 25 mm. For the purpose of growth estimation the length frequency data from trawl and drift gill net were used as these gears are operated in the same fishing ground. A com-

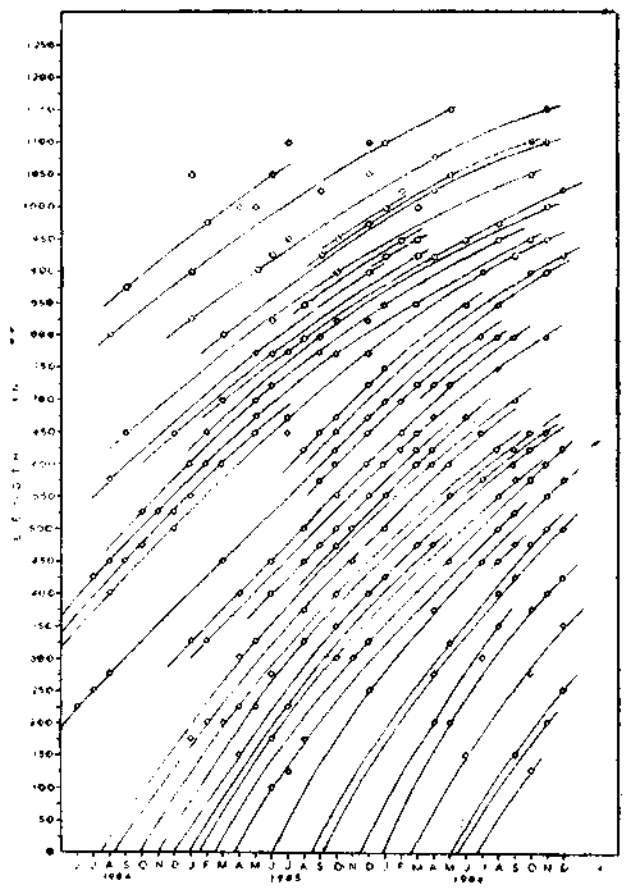

Fig. 1. Tracing of the progression of modes by scatter diagram of modal length-month for *Scomberomorus commerson* from Tuticorin

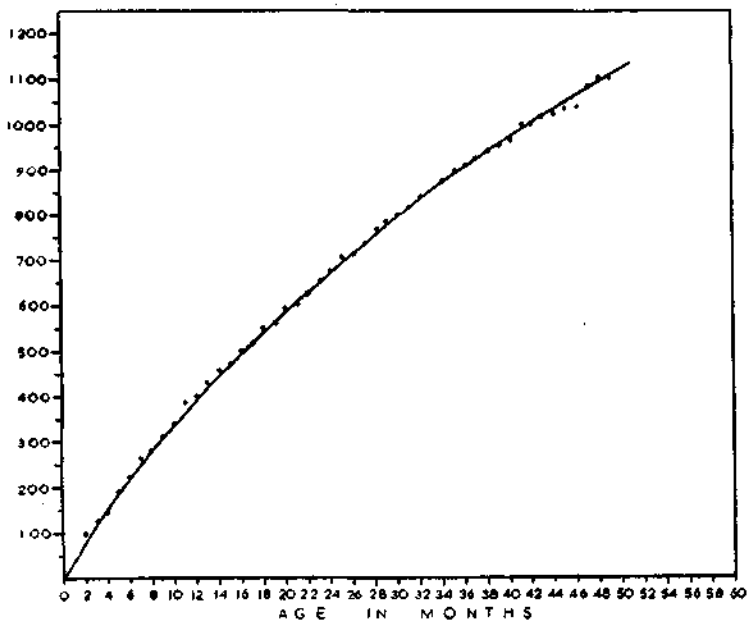

Fig. 2. Mean length at age in months based on the scatter diagram for *S. commerson* form Tuticorin.

bination of "Petersen method" and "Modal progression analysis" was used by plotting the modal lengths in the length frequency in the form of a scatter diagram. The progression of the modes is indicated by eye-fitted lines and these lines are extrapolated free hand so that they intersect the time axis indicating the time of brood origin as shown in Fig 1. The average sizes obtained from the modes traced in this way indicate roughly the length attained by the king seer in consecutive months These values were plotted against respective months and the curve fitted through the plots represents the growth curve of this species (Fig 2). The half yearly growth of this species obtained from this analysis is 224 mm, 382 mm, 529 mm, 665 mm, 796 mm, 907 mm, 1015mm and 1088 mm in 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 years respectively. These data were further analysed as per the method of Bagenal (1955) by regressing L_{t+1} on L_t to obtain growth parameters like $L\infty$, K and t_0. The growth in length of *S. commerson* may be expressed as per von Bertalanffy growth equation, $L_t = 1938\ (1 - e^{-0.2006\ (t\ +\ 0.0886)})$ and the growth in weight, $W_t = 32002\ (1 - e^{-0.2214\ (t\ +\ 0.1287)})^3$.

Mortality rates

The total mortality coefficient (Z) is estimated for *S. commerson* as per Beverton and Holt (1956) method from the relation $Z = \frac{K\ (L\infty - \bar{L})}{\bar{L} - Lc}$ where $L\infty$ and K are parameters of von Bertalanffy growth equation, $\bar{L}$ is the mean length in the catch and Lc is the mean length at first capture. Lc is normally estimated from selection experiments, which, however, are rather time and resource consuming. The Lc of *S. commerson* for different gears have been estimated from the ascending limbs of the catch curves of the respective gear (Pauly, 1934; Devaraj, 1983) and it varied from gear to gear depending on its selectivity. The estimates of Z obtained by the above said method for different gears are given in Table 3.

The natural mortality coefficient (M) is estimated by regressing the annual effrort on Z as per the relation $Z = M + qf$, where q is the catchablity coefficient, which relates f and fishing mortality rates (F) through $F = q \times f$.

TABLE

Estimates of Z obtained from the average mean size at first capture (Lc) as per

Year	PARUVALAI (Lc 512.5mm) Effort (units)	L (mm)	Z	F	HOOKS & LINES (Lc 575mm) Effort (units)	L (mm)	Z	F
1980	3874	698.8	1.33	1.05	11723	815.7	0.94	0.56
1981	3964	681.3	1.49	1.07	7462	869.0	0.73	0.36
1982	4049	664.6	1.68	1.10	8979	848.3	0.80	0.43
1983	1584	778.9	0.87	0.43	10476	832.6	0.86	0.50
Average	3368	705.9	1.28	0.91	9660	841.4	0.83	0.47
Catchability coefficient 'q'		0.000271125				0.000048121		
M		0.43				0.37		
Average M		1.28 - 0.91 = 0.37				0.83 - 0.47 = 0.36		

Considerable difficulties are experienced in obtaining reliable estimates of M for tropical fishes by several workers (Pauly, 1980; Srinath and Alagarja, 1982; Yohannan, 1982; Devaraj, 1983). In the present study, M varied from 0.37 in hooks and line to 0.57 in trawal net. The independent estimate of M for *S. commerson* as per Pauly (1980) is 0.45. Devaraj (1983) has estimated the M to be 0.4 for this species in Palk Bay. The average value of M obtained from all the four gears is 0.48 (Table 3).

Yield per recruit

Yield per recruit estimated as functions of different fishing mortality rates and keeping the age at first capture constant for different M/K ratios are shown in Fig 3. The 'F max' which can produce the highest yield increases with the increase in M/K ratio. Yield per recruit estimated as functions of varying fishing mortality rates and different age at first capture for the prevailing M/K ratio 2.0 are given in the from of yield isopleth diagram in Fig 4, wherein the eumetric fishing curve (line A-A) and maximum sustainable yield curve (line B-B) are also given. The optimum age of exploitation is defined as the age when the brood attains its maximum weight (Beverton and Holt, 1957) and potential yield per recruit is the quantity corresponding to this weight as a function of infinite fishing intensity (Ricker, 1945; Holt, 1968). The estimated optimum age

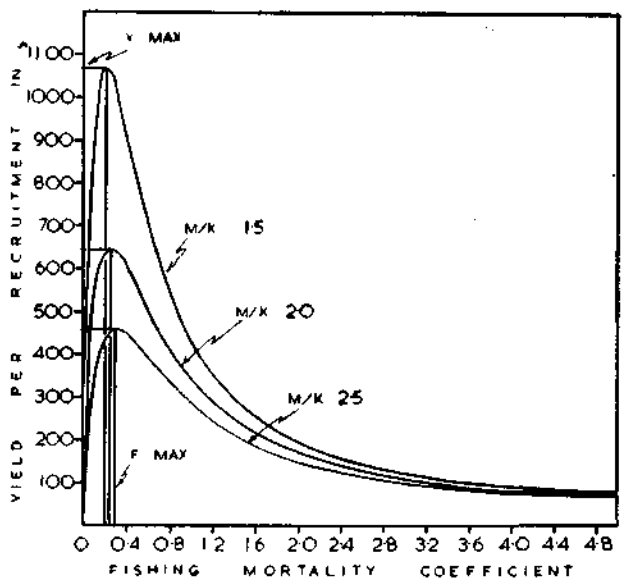

Fig. 3 Yield per recruitment of *S. commerson* at different M/K ratios and various fishing mortality coefficients. The corresponding yield max and F max are indicatnd for each curve.

of exploitation for *S. commerson* is 3.88 years and the potential yield per recruit estimated as per Krishnankutty and Qasim (1968) is 1749 g which is indicated in the yield isopleth diagram. The age at first capture pertaining to different gears presently employed in Tuticorin are indicated in the isopleth diagram with yield max and corresponding F which can produce the yield max.

3.

Beverton and Holt method (1956) and estimates F by regressing effort on Z.

	PODIVALAI (Lc 326 mm)				TRAWL NET (Lc 212 5 mm)			
Effort units)	L (mm)	Z	F	Year	Effort (units)	L (mm)	Z	F
1791	408.2	3 69	2.90	1984	29003	359 6	2.15	1.53
531	498 5	1.66	0.86	1985	38177	342.2	2.47	2.04
1119	466.2	2.90	1.81	1986	44228	321.3	2.98	2.34
1206	458.7	2.22	1.95					
1162	457.9	2.23	1.88		37136	341.0	2.49	1.97
	0.001609574					0.00005292		
	0.55					0.57		
	2.23-1.88 = 0.35					2.49 - 1.97 = 0.52		

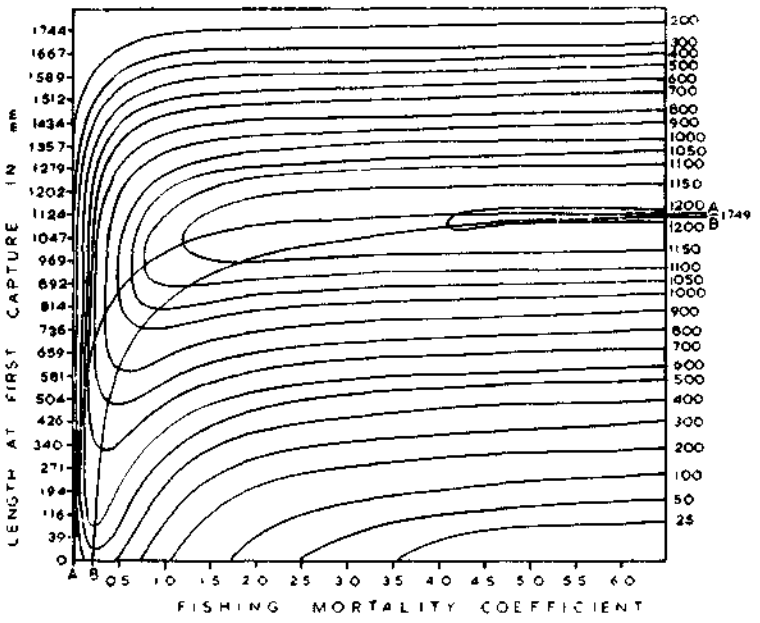

Fig. 4. Isopleth diagram for yield per recruit in grams of *S. commerson* population in Gulf of Manner. The line A-A indicates the eumetric fishing curve and the line B-B the maximum sustainable yield curve. The potential yield per recruit of 1749 g is also shown.

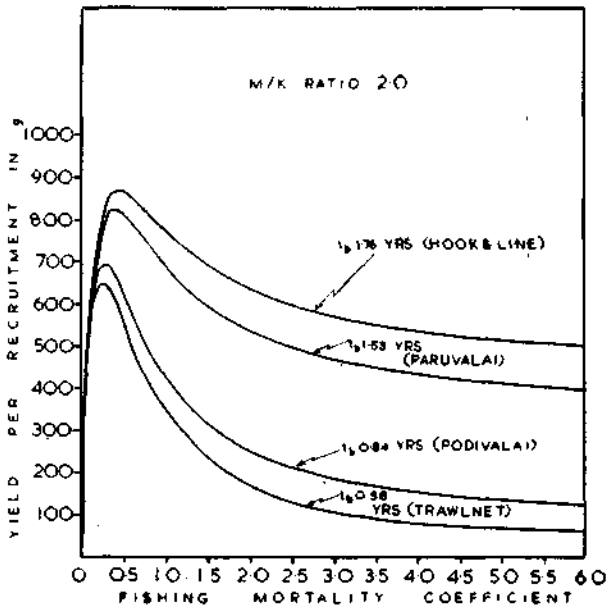

Fig. 5. Yield per recruitment of *S. commerson* at different fishing mortality rates and different age at first capture pertaining to different gear for the prevailing M/K ratio 2.0.

The yield per recruit for different age at first capture pertaining to different gears are shown in Fig 5. The F max which can produce the yield max has not exceeded 0.5 for any of the gears; whereas the prevailing fishing mortality coefficient of these gears are well above 0.5 except the F for hooks and line (Table 3). This indicates that the present effort input by by *paruvalai, pohivalai* and trwal net in Tuticorin is higher than the required levels and do not commensurate with the yield The stock of *S. commerson* is under higher fishing pressure by these gears in Tuticorin waters. The increase in the overall production of seer fish by further increase in the effort of any of these gears without due consideration on the increase

in age at first capture, may not be appreciable as the yield per recruit tend to decline in higher fishing intensity for the prevailing age at first capture.

FISHERY MANAGEMENT

The fishery of seer fish in India is supported by the king and spotted seer whereas in Gulf of Mannar it is mostly by the king seer. The suggestions made here are valid only for Gulf of Mannar as the present study deals with the data collected at Tuticorin coast in detail. The fishing mortality coefficient, which varied from 0.47 for hooks and line to 1.97 in trawl net indicates that the present effort input by all the gears except hooks and line are higher than the required optimum effort and the yield is not commensurate with the effort expended. A moderate increase in age at first capture by these gears may improve the yield. Increase in mesh size. Increasing the mesh size of trawl net is not possible as the main aim of this gear is to exploit some other resource. Since as much as 113.4 t of seer fish of mostly smaller size groups are landed by trawl net, this gear may be considered as the most unfavourable for the exploitation of seer fish. *Podivolai* is mainly employed to exploit the resources like hilsa. chirocentrids, mackerel, belones etc. Though a very limited number of *podivalai* are in vogue, this gear is also not suitable for proper exploitation of seer fish. Therefore, *paruvalai* with increase in mesh size to 170-190 mm and hooks and line may be considered well suited for the exploitation of this resource and operation of fhese gears may be encouraged for easing the prevailing higher fishing pressure and to increase the seer fish production as well.

REFERENCES

ANON. 1986. Marine fish production in India during 1983-'84 and 1984-'85. *Mar. Fish. Infor. Serv. T & E Ser.* 67 : 1-79.

BAGENAL, T. B. 1955. The growth rate of the long rough dab *Hippoglossoides platessoides* (Fabr.). *J. Mar. Biol. Ass. U. K.*, 34 : 297-311.

BEVERTON, R J. H. AND S. J. HOLT. 1956. A review of the methods for estimating mortality ratio in exploited fish populations with special reference to source of bias in catch sampling. *Rapp. Cons. Explor. Mer.*, 140 (1) : 67-83.

BEVERTON, R. J. H. AND S. J. HOLT. 1957. On the dynamics of exploited fish populations. *Fishery Investigations* (Ministry of Agriculture, Fisheries and Food, London), *Series* 2, 19 : 533 pp.

CHACKO, P. I., S. D THOMAS AND C. MALUPILLAI. 1962. Scombroid fisheries of Madras State, India. *Proc. Symp. Scombroid fishes*, MBAI, 3: 1006-1008.

DEVARAJ, M. 1977. The biology and fishery for the seer fishes of India. Thesis submitted to the Madurai Kamaraj University for the award of Ph. D. degree, pp 337.

DEVARAJ, M. 1983. M. 1983. Fish population dynamics-Course manual. *CIFE Bulletin*, 3 (10), pp. 98.

HOLT, S. J. 1958. The evaluation of fisheries resources by the dynamic analysis of stocks, and notes on the time factor involved. *Pec. Publs. Int. Comm. NW, Atlant. Fish.*, 1 : 77-95.

HORNELL, J. 1917. A statistical analysis of the fishing industry of Tuticorin (South India). *Madras Fish. Bull.*, 11 : 67-117.

KAIKINI, A. S. 1960. The fishes of Malwan. *Indian J. Fish,*, 7 : 348-368.

KRISHNAMOORTHI, B. 1957. Fishery resources of the Rameswaram Island. *Indian J. Fish.*, 4 (2) : 229-253.

KRISHNAN KUTTY, M AND S. Z. QASIM. 1968. The estimation of optimum age of exploitation and potential yield in fish populations. *J. Cons. perm. int. Explor. Mer.*, 32 (2) : 249-255.

KUMARAN, M. 1962. Observations on the food of juveniles of *Scomberomorus commerson* (Lacepede) and *S. guttatus* (Bloch and Schneider) from Vizhinjam, West coast of India. *Proc. Symp. Scombroid Fishes*, MBAI, 2 : 586-590.

KASIM, H. M. AND MOHAMMAD ZAFAR KHAN, 1986. A preliminary account on the gill net fishery off Veraval during 1979-82. *Indian J. Fish.*, 33 (2) : 156-162.

NAYAR, S. G. 1958. A preliminary account of the fisheries of Vizhinjam *Indian J.* Fish., 5 : 32-55.

PAULY, D. 1980. A selection of simple methods for the assessment of tropical fish stocks. *FAO Fisheries Circular* 729, FIRM/129, pp. 54.

PAULY, D. 1984. Length converted catch curves: A powerful tool for fisheries Research in the tropics (part II)[e]. *Fishbyte*, 2 (1) : 17-19.

RAO, G. SUDHAKARA AND H. MOHAMAD KASIM. 1985. On the commercial trawl fishery off Veraval during 1979-82. *Indian J. Fish.*, 32 (3) : 296-308.

RAO, K. SRINIVASA. 1962. Observation on the food and feeding habits of *Scomberomorus guttatus* (Bloch & Schneider) and juveniles of *S lineolatus* (Cuvier & Valenciennes) and *S. commerson* (Lacepede) from the Waltair coast. *Proc. Symp. Scombroid Fishes*, MBAI, 2 : 591-598.

RICKER, W. E. 1945. A method of estimating minimum size limits for obtaining maximum yield. *Copeia*, No. 2 : 84-94.

SILAS, E. G. 1962. Tuna fishery of the Tinneveli coast, Gulf of Mannar. *Proc. Symp. Scombroid Fishes*, MBAI, 3 : 1083-1118.

SRINATH, M. AND K. ALAGARAJA. 1982. A method of estimation of mortality rates from length samples. *Indian J. Fish.*, Vol 29 (1 & 2) : 183-188.

VIJAYARAGHAVAN, P. 1955. Life history and feeding habits of the spotted seer *Scomberomorus guttatus* (Bloch & Schneider). *Indian J. Fish.*, 2 : 360-372.

YOHANNAN, T. M. 1982. Population dynamics of Indian mackerel based on data from Mangalore during 1967-75. *Indian J. Fish.*, 29 (1 & 2) : 50-62.